

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
1998 Biennial Regulatory)	ET Docket No. 98-42
Review – Ammendment of)	
Part 18 of the Commission’s)	
Rules to Update Regulations)	
For RF Lighting Devices)	

**Reply of Fusion Lighting, Inc. to Joint Supplemental
Comments of Sirius Radio, Inc. and XM Radio, Inc.**

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Summary

The DARS licensees have come before the Commission claiming that Fusion lamps will cause unacceptable interference to DARS receivers. Having failed to conduct the due diligence expected for any party seeking a spectrum license, and having ignored the Commission's warning that a license obtained by auction is not a guarantee of business success, the DARS licensees only now assert that their sensitive receivers will not function acceptably unless out-of-band emissions from Fusion lamps are reduced at least 45 dB below the current limits set forth in the Part 18 Rules.

Simply stated, the DARS licensees are asking the Commission to order Fusion to reduce the out-of-band emission limits from its lamps by more than 99% below the current Part 18 limits and more than 96% below the Commission's proposed out-of-band emission limits for these products.

On November 3, 2000, at the request of Fusion Lighting Inc. (Fusion), PC Test of Columbia, Maryland conducted radiated emissions tests of six Fusion sulfur lamps to determine their out of band emission levels. These tests were observed by representatives of Sirius Satellite Radio, Inc. ("Sirius") and XM Radio, Inc. ("XM") (together, the "DARS licensees).

The November tests showed that Fusion's magnetron-driven sulfur lamps easily comply with the Commission's existing out-of-band emission limits for RF lighting devices and even the more stringent out-of-band emission limits proposed in this proceeding. Based on these tests, the DARS licensees contend that their system, as currently designed, will experience harmful interference from the Fusion lamps. Assuming that the sensitivity of the DARS receivers and the DARS link budgets are as reported in previous filings with the Commission, Fusion agrees that these systems will indeed experience harmful interference.

The Commission has been aware of the Fusion lamps for many years. The DARS licensees should be presumed also to have been aware of the Fusion lamps, long a matter of public record, when they bid for the licenses to operate DARS systems. The Commission carefully warned all bidders in the DARS auction that it was up to them to conduct due diligence and that the Commission was not guaranteeing the success of the

DARS business ventures. Nonetheless, Sirius and XM bid large sums for their DARS licenses and then embarked on a risky system design that it knew to be intolerant of ISM out-of-band emissions.

Fusion explains herein that it has investigated all known methods of reducing out-of-band emissions from its RF lamps and has yet to discover any method that will approach the limits requested by the DARS licensees. Even a modest (and from the DARS licensee's point of view, useless) decrease in emissions would come at a prohibitive cost and result in lamps too large and heavy to market or lamps which will produce no light. Given present technology, Fusion cannot produce a lighting device that would come close to satisfying the needs of the DARS licensees.

As Fusion shows, however, the DARS licensees have it within their power, if not their present business plan, to resolve interference problems from RF lighting through the use of terrestrial repeaters which are already being deployed in the same environments where Fusion lights can be expected to proliferate – cities and their surrounding areas. Terrestrial repeaters, always envisioned as an integral component of DARS service, can easily render DARS receivers immune to out-of-band emissions from various ISM sources, including microwave ovens and Fusion's lights.

That the DARS licensees have paid for the use of their spectrum does not obligate the Commission to invoke its processes to guarantee DARS reception by wiping out two decades of public and private funding in Fusion lighting and destroying the promise of low cost, energy efficient, outdoor lighting. And it is not the responsibility of Fusion or the Commission to assure business success for the DARS licensees.

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Amendment of Part 18 of the)	
Commission's Rules to Update)	
Regulations for RF Lighting Devices)	

**Reply to Joint Supplemental Comments of
Sirius Satellite Radio, Inc. and XM Radio, Inc.**

Fusion Lighting, Inc., ("Fusion") by its attorneys, hereby files its reply to the Joint Supplemental Comments of Sirius Satellite Radio, Inc. ("Sirius") and XM Radio, Inc. ("XM") (together, the "DARS licensees"), in the above-captioned proceeding.

Introduction

On November 3, 2000, PC Test of Columbia, Maryland conducted radiated emissions testing of six Fusion sulfur lamps.¹ At Fusion's invitation, representatives of the DARS licensees observed these tests. The DARS licensees have filed their Supplemental Comments in this proceeding, discussing the test report and offering their own analysis of the data. Omitted from the supplemental Comments and the DARS licensee's Analysis, but made absolutely clear from the test report is that:

¹ See Exhibit A, "Product Evaluation Report," PC Test Lab, November 3, 2000. The DARS licensees tested a seventh light which was not a part of the PC Test joint testing, but which was unaccountably included in their test analysis. This seventh light is an early developmental lamp installed at the Department of Energy in Washington, D.C. The DOE lamp employs a DC switching power supply which Fusion experimented with some years ago but found to be technically unreliable and prohibitively expensive. Fusion lamps use a ferroresonant power supply. The DOE lamp was an experimental model that is not sold commercially and the DARS licensees were told of this, yet they have persisted in treating the DOE lamp as somehow representative of present Fusion lamps. This is not the case. See page 13 *infra*.

- Every Fusion lamp measured during joint testing demonstrated compliance with the average emission limits under Part 18 Rules in the DARS band by a margin of **at least 20 to 34 dB.**
- One of the Fusion lamps (sample #1227), despite being 20dB below the FCC's Part 18 limits, will cause unacceptable interference to DARS receivers unless peak emission levels are **reduced an additional 59dB – or more than 99.9% below their lawful limits.**
- If the peak emission levels from sample lamp #1227 are not reduced to the levels required by the DARS licensees, unacceptable interference to DARS receivers will occur at a distance of **1800 meters – or over one mile.**

Significantly, the DARS licensees freely admit that:

- Interference to DARS receivers caused by Fusion lamps can be overcome by deploying additional terrestrial repeaters.

Incredibly, the DARS licensees seek drastic Commission relief for problems of their own making, requesting limits on Fusion Lighting that would effectively ban its magnetron-driven products. And it is no small irony that while the Commission deliberates this matter, the Fusion lamp is prominently featured in Vice President Cheney's just-released Report on National Energy Policy, as an example of breakthrough technology in the area of energy conservation.²

A detailed analysis of the November 2000 tests and Fusion's response to the DARS licensees Supplemental Comments are provided below. Fusion believes, however, it is not merely useful, but critical to briefly review the history of this proceeding, Fusion's use of the 2450 MHz band, and the Commission's decision to allocate the 2320-2345 MHz band for DARS use.

History

Approximately 25 years ago Fusion engineers approached the Commission's staff to discuss their plans for developing "microwave excited" lamps. The 2.45 GHz ISM band was identified by the staff as the ideal location for Fusion's ISM product offerings

² In outdoor lighting applications alone, Fusion's magnetron-driven products have the potential to save consumers over \$6 billion a year based on recent wholesale electricity costs.

because it was internationally harmonized, allowed unlimited ISM emissions and contained very few radio services. Fusion developed its lighting technologies based on the low cost 2.45 GHz magnetron used in hundreds of millions of microwave ovens worldwide. In 1990, Fusion adapted this technology for its revolutionary electrodeless sulfur lamp.

In 1991, at the urging of Sirius (then CD Radio, Inc.), the United States recommended to the 1992 World Administrative Radio Conference (WARC) that spectrum in the vicinity of the 2300-2390 MHz band be allocated internationally to the Digital Audio Broadcasting Service (DAB).³ Even at that time, concerns were raised by the ISM community about the potential out-of-band emissions from ISM equipment operating in the 2.45 GHz band.⁴ The Commission, heeding these warnings, determined to select a portion of the band that would minimize the likelihood that DAB would be subject to harmful interference from ISM equipment.

In 1992, Fusion tested its new sulfur lamps and verified compliance with the Commission's Part 18 (ISM) rules. Then, as now, there were no Part 18 limits for out-of-band emissions above 1 GHz for RF lighting devices. Lacking such a specified limit, Fusion designed its lighting system to meet the Part 18 limits for "miscellaneous" ISM devices set forth in Section 18.305(b). This is the same limit that was used by FCC Laboratory engineers four years later in testing the Fusion lamp.

In November of 1992, the Commission proposed to allocate the 2310-2360 MHz band for DAB Services. Ultimately, in 1995, the Commission chose the 2320-2345 MHz band for what by then had become known as the Digital Audio Radio Satellite Service. In neither proceeding was there any discussion by DARS proponents or the Commission of interference from ISM equipment, the Commission's concern of three years earlier.

In March, 1996, at the request of the FCC Laboratory staff, Fusion supplied a sample of its sulfur lamp for EMC testing. The tests showed that the device complied with all Commission rules.⁵ As noted, the FCC Laboratory staff measured out-of-band

³ See *In the Matter of An Inquiry Relating to Preparation for the ITU WARC for dealing with Frequency Allocations in Certain Parts of the Spectrum*, Gen. Docket No. 89-544, Report, 69 RR 2d 484, 494 (1991)

⁴ Fusion participated in the FCC docket that led to the recommendations for the WARC proceeding.

⁵ See Exhibit B, May 3, 1996 Memorandum to Chief Customer Service Branch from TPhillips, FCC Labs test engineer.

emissions in the DARS band against the requirements of Section 18.305(b) for miscellaneous ISM equipment.

By 1996, Fusion was already gaining favorable publicity for its sulfur lamps outside the corridors of the Commission. As Fusion noted in a presentation to the Office of Engineering and Technology in connection with earlier proceedings in this Docket, its sulphur lamp technology had, by then, received support from the Department of Energy, the Environmental Protection Agency, and the National Air and Space Administration. Around this time, Fusion had also participated in various FCC proceedings and there were numerous newspaper articles about its revolutionary new lighting system. By May, 1996, when a waiver requested by Fusion and General Electric led to the initial stages of this proceeding, Fusion lamps were well established as a matter of public record.

On March 3, 1997, the Commission adopted service rules for DARS. Three days later, it issued a Public Notice of the auction to award DARS licenses and explained the auction ground rules. Potential bidders were reminded that they were responsible for familiarizing themselves thoroughly with the procedures, terms and conditions of the Notice and further, that it was their “responsibility to remain fully informed regarding all FCC rules and Public notices pertaining to this auction.” Most importantly, the Commission warned:

[t]he FCC makes no representations or warranties about the use of this spectrum for particular services. Applicants should be aware that an FCC auction represents an opportunity to become an FCC licensee in this service, subject to certain conditions and regulations. An FCC auction does not constitute an endorsement by the FCC of any particular services, technology or products, nor does an FCC license constitute a guarantee of business success. Applicants should perform their individual due diligence before proceeding as they would with any new business venture. (Emphasis in the original).

A month later, Sirius and XM bid approximately \$83 million and \$89 million respectively, for their DARS licenses.

In April 1998, prompted by requests by Fusion and General Electric for waivers of the Part 18 conducted limits, the Commission took the opportunity also to propose out-of-band emission limits above 1 GHz specific to RF lighting, explaining that the present rules, “may not easily accommodate technological developments in RF lighting and thus

hinder the further development and implementation of these new products.” Apparently remembering its concerns of seven years earlier about spurious emissions from ISM devices into a proposed DARS band, the Commission proposed that RF lighting devices operating above 1 GHz should now meet the same out-of-band emission limits imposed on digital devices. This represented a significant tightening of the Part 18 limits otherwise allowed for “miscellaneous” ISM devices under Section 18.305(b).

It was at this point that the DARS licensees apparently awoke to their problem and hastily performed some “Monday morning” due diligence. They argued then, as they do now, that the proposed limit was wholly inadequate to protect their sensitive digital radio receivers and instead urged that the out-of-band limit for RF lighting devices be set to a limit no greater than $18 \mu\text{V/m}$ @ 30 meters,⁶ representing more than a 99.9% reduction in historically allowable limits, and a 96% reduction from the limits newly proposed for consideration by the Commission. By making this demand on RF lighting, the DARS licensees crossed well beyond the threshold of reasonableness into the realm of impossibility.

Meanwhile, a few blocks of the Commission, a Fusion lamp has been on display in the East Wing of the Smithsonian Institution’s Museum of American History as part of an exhibit celebrating the “evolution and revolution” of lighting in the United States. The Fusion lamp is just steps away from the incandescent light bulb invented by Thomas Edison.

Results of the November 2000 Tests of Fusion Lamps

As the following chart shows, emissions from all six Fusion lamps that were tested by PC Test, when measured according to long standing Commission practice, are lower not only than existing out-of-band emissions standards under Part 18 but also lower than the Commission’s proposed out-of-band limits for digital devices.

⁶ 25 dB $\mu\text{V/m}$ at 3 meters

Fusion Lamp Sample No.	dB below Sec. 18.305(b) limit in dB μ V/m at 3 meters	dB below FCC proposed limit in dB μ V/m at 3 meters
1227	-20	-4
587	-27.7	-11.7
563	-26.1	-10.1
06	-30	-14
05	-33.6	-17.6
04	-27.6	-11.6

These measurements were made using a 30 Hz Video Bandwidth (VBW) even though a 10 Hz VBW is the appropriate VBW setting for measuring average field strength from a Fusion lamp⁷ and could be expected to yield lower results. According to Fusion engineers, the variation in measurements is a result of the differing ages of the lamps tested as well as their designed purpose. Sample No. 1227, for instance is a lamp with a large 16” reflector designed specifically for wide-area lighting applications.

Magnetron-Driven ISM Products such as Fusion Lamps and Microwave Ovens Have Always Been Measured by the FCC Labs Using a 10Hz Video Bandwidth

The DARS licensees claim that the Commission has yet to adopt a standard VBW setting for measuring emissions from magnetron-driven RF lighting devices.⁸ Accordingly, the DARS licensees choose a VBW setting of 1MHz in order to derive a peak level that “most accurately depicts the effect of out-of-band emissions from RF lights on satellite DARS receivers.”⁹ In fact, however, the Commission has had a longstanding policy for measuring average field strengths from magnetrons by using a 10Hz VBW setting whether these devices are employed in the microwave ovens or in Fusion lamps.¹⁰ If peak measurements are taken using the 1MHz VBW setting preferred by the DARS licensees, it is obvious that several of the Fusion test lamps would appear to exceed the Part 18 limits. But Fusion designed its lamps years ago, with the Commission’s blessing, to comply with average, not peak limits, based on measurement

⁷ See Exhibit C, March 5, 1999, letter from R.LaForge, Chief Customer Service Branch, to M. Ury, Fusion Lighting.

⁸ Supplemental Comments at 8.

⁹ *Id.*

¹⁰ See fn. 6 *supra*

procedures used and recommended by the Commission for decades. Fusion cannot now be penalized, as the DARS licensees demand, by forcing an abrupt change in the Commission's magnetron measurement procedures solely to protect digital radio receivers that were not designed to account for well known out-of-band emissions from ISM sources. The DARS licensees have offered no credible reason for changing a decades-old test procedure to limit the potential interference of millions of consumer and commercial microwave ovens in use today throughout the U.S.¹¹

Interference to DARS Systems

The DARS licensees maintain that their systems are so sensitive that out-of-band peak emissions from Fusion's lamps must be lower than 25dB μ V/m at 3 meters.¹² Fusion and the Commission must take the DARS licensees at their word since they have never provided a sample receiver to test. However, assuming the DARS licensees have accurately described their receiver sensitivity, there is no question that at significant distances Fusion lights will interfere with, or block entirely, DARS satellite signals.

Just how sensitive the DARS receivers are is apparent from the umbrella of protection sought in the Supplemental Comments. According to the DARS licensees, one of the Fusion lamps, Sample No. 1227, would have to be located 1800 meters -- over a mile away -- from a DARS receiver to escape unacceptable interference. Yet this lamp currently emits less than 1/10 of the field strength permitted under the current rules!¹³ Even the experimental DOE lamp, which is not a commercially feasible model and was not part of the November testing but which operates at 1/100 of the present lawful limits, would have to be located at least 63 meters from a DARS receiver to avoid unacceptable interference.¹⁴

¹¹ There is no logic for treating microwave oven emissions differently than Fusion lamps as both employ the same 2.45 GHz magnetron.

¹² To place this huge reduction in perspective, a 25dB μ V/m peak measurement would result in average measurements that are virtually unmeasurable - buried within the noise - using conventional measurement techniques.

¹³ Supplemental Comments at 11.

¹⁴ *Id.*

How this situation came about is surely relevant to the outcome of this proceeding. Quite possibly, in the frantic competition to succeed at the Commission's DARS auction, both Sirius and XM failed to account for the significant potential interference from Fusion lamps. Or perhaps they relied then, as they apparently still rely on their large auction payments to not only buy use of the spectrum but also a guarantee of success from the Commission. If so, their reliance was misplaced. As the Commission has repeatedly stated, the purchase of spectrum confers no special rights on licensees and, like other spectrum risk takers, the DARS licensees cannot look to the Commission to underwrite their commercial offerings.

The Degree of Protection Sought is Unprecedented

The effect of the DARS request is to force Fusion to reduce its out-of-band emissions levels by 45 dB.¹⁵ Fusion is not aware of any instance in which the Commission has ever required a manufacturer of existing lawful devices to reduce emissions to such a dramatic extent. To do so would undoubtedly be punitive under the law – an effective taking of property by the Commission in derogation of Fusion's Constitutional rights. Indeed, if the DARS licensees succeed in this effort the result will be a 2.45 GHz RF lamp that produces no useful light.¹⁶

In *ex parte* presentations in this proceeding, the DARS licensees have made much of the fact that the Commission imposed similar, stringent out-of-band emission limits on the Wireless Communications Service ("WCS"), a licensed service. Again, a bit of historical perspective is useful. The WCS was hastily established pursuant to a Congressional mandate in the Appropriations Act of 1997. The Commission was given mere months to allocate the 2305-2320 MHz band and to auction it off. The only guidance from Congress, other than the extraordinary timetable, was that the spectrum be allocated consistent with international agreements for fixed, mobile, radiolocation and

¹⁵ The Part 18 limits for miscellaneous ISM in the DARS band is approximately 70 dBµV; the DARS licensees request a limit on Fusion lamps of 25 dBµV.

¹⁶ It must be emphasized that the Commission is not engaged in an enforcement proceeding where it is alleged that Fusion's lamps are overpowered. As demonstrated by an independent testing, Fusion lamps more than comply with the Commission's rules. Quite simply, Fusion has done nothing that deserves such punitive measures.

BSS (sound), along with complementary terrestrial sound broadcasting. The Commission did not have the time to determine whether the spectrum should be allocated for specific services within these general categories, so it was forced instead to adopt a general allocation permitting use of any of the services listed in the international allocation. Thus, not knowing what the service would be used for, the Commission adopted severe interference restrictions (which, in a sense, took the place of more specific allocations) to prevent interference to other services including the DARS service for which service rules had been adopted only a month earlier. These restrictions were so severe that the Commission acknowledged certain services might be effectively precluded from using the spectrum at all.

WCS is hardly a paradigm for protecting DARS. Congress told the Commission what spectrum to allocate, gave it almost no time to do it and paid no attention to existing allocations that might be adversely affected. On its own, the Commission adopted rules to protect DARS from a radio service that had yet to come into existence. The end result is that many potential services cannot use the WCS spectrum so that the then existing DARS licensees would be protected.

Methods of Mitigating Out-of-Band Interference

The DARS licensees insist that Fusion re-design its product to eliminate all threats of interference to DARS service. They contend that better out-of-band performance may be accomplished through some combination of “filtering, shielding and a more RF ‘quiet’ power supply” and that Fusion can decrease out-of-band emissions “below levels emitted by the DOE experimental lamp installation.”¹⁷ They further assert that a comparison of various Fusion models demonstrates that “better out-of- band performance is technically possible...[and]... not necessarily costly.”¹⁸ Finally, they state that out-of-band emissions can be greatly reduced by using direct current switching power supplies and specialized magnetrons “without reducing [the lamps’] luminous

¹⁷ Supplemental Comments at 5.

¹⁸ *Id.* at 4, note 11.

capabilities.”¹⁹ None of these statements has any basis in fact and, moreover, the underlying technical issues -- shielding, filtering and specialty components -- have already been discussed and analyzed extensively in this proceeding. The conclusion reached then, as now, refutes any notion that Fusion’s lamps can be modified to comply with emission limits anywhere close to the levels advocated by the DARS licensees; the only possible solution is a complete redesign of the 2.45 GHz magnetron.

Conventional filtering techniques for lamp emissions have been explained and discussed at length in this docket.²⁰ Fusion described to the Commission and the DARS licensees how its current lamp design contains two stages of RF filtering to reduce in-band and out-of-band emissions; a primary screen that surrounds the quartz bulb and an a metal-oxide cover glass that fits over the lamp reflector. Together these filters reduce emissions in-band by 56dB but at a considerable cost – over 20% -- in lighting efficacy (*i.e.* lumens per watt).²¹ “Heroic” shielding efforts were also attempted by Fusion engineers to further reduce emissions but lighting efficacy dropped so precipitously that the lamp was quickly rendered non-competitive.²² The DARS licensees’ wild assertion that emissions from Fusion lamps can be filtered an additional 36dB at a loss in “efficiency” of only 15% omits these critical facts. Even if a competitive lamp could be produced at such reduced efficiency it would still emit at levels far in excess of what the DARS licensees claim is needed for acceptable satellite reception.

Recently, Fusion investigated the possibility of inserting some type of narrowband filter in its lamp assembly to choke off DARS band emissions. Attached hereto in Exhibit D is an engineering study commissioned by Fusion which concludes that narrowband filtering using waveguide technology, the only feasible approach, is not a viable option for magnetron lighting. Wholly apart from the cost impact which Fusion believes would be significant, narrowband filtering is not feasible based on the size/weight limitations for the lamps as well as other technical constraints explained in the study.

¹⁹ *Id.* at 14.

²⁰ See May 19, 1999 *ex parte* letter from TMahn to MSalas, ET Docket No. 98-42; August 26, 1999 *ex parte* letter from TMahn to MSalas, ET Docket No. 98-42; September 3, 1999 *ex parte* letter from KKIpling to MSalas, ET Docket No. 98-42

²¹ See August 26, 1999, *ex parte* letter *supra*. Out-of-band measurements (e.g. DARS band) were not made so it is not clear whether these filtering effects will scale in accordance with the in-band measurements.

²² See May 19, 1999, *ex parte* letter *supra*.

As for using DC switching power supplies and/or specialized magnetrons, the record in this docket is clear that both are still very much the stuff of dreams. The DARS licensees conveniently overlook the fact that the DOE lamp, on which they base much of their technical analysis, is an experimental product that has no commercial value. This has been a matter of record in this proceeding for nearly two years and moreover, Fusion engineers explained this carefully to the DARS engineers at their joint meeting with the FCC staff on October 16, 2000. There Fusion explained that the DOE lamp uses a DC switching power supply that was found to be unreliable, exhibits an unacceptably short lifetime (5000 hours as compared to 60,000 for ferroresonant supplies) and raises the end user cost of a lamp by \$1200 -- or 4 to 8 times the cost of a complete system sold by lighting competitors.²³ Fusion also noted that the experimental power supplies it has sampled cannot be installed reliably outside clean, thoroughly protected environments.²⁴ For the DARS licensees to base their technical arguments on a design they know to be experimental and not close to being commercially viable, only underscores the desperate nature of their arguments.

And their reference to the use of "specialized" magnetrons as a possible solution to their interference problem is even farther off the mark. While it may be possible to find a magnetron that is capable of salvaging 2 or 3 dB of attenuation, a magnetron that would afford an extra 40 to 50 dB of protection is not available. Even if large margins of attenuation for DARS band shielding could be implemented at the magnetron manufacturing level, and there is no basis in the literature for believing that this could be done, it is clear that the costs would be prohibitive for a lighting application and would doom a competitive offering by Fusion.

At the Commission's repeated urging throughout this proceeding, Fusion spent three years investigating all possible options for improving the RF design of its magnetron lamps. It has exhausted every lead, performed or commissioned multiple engineering analyses and ultimately concluded that it cannot make any significant in-road to the RF shielding paradox²⁵ without sacrificing its competitive position in the market.

²³ See September 3, 1999, *ex parte* letter *supra*.

²⁴ *Id.*

²⁵ The paradox in RF lighting comes from the fact that both the RF and the light travel together such that one must always be traded off in favor of the other.

The DARS licensees are advised to reread the record in this docket to understand the futility of their baseless proposals.

The DARS Licensees Have it Within Their Own Power to Eliminate the Interference Problem

As was envisioned by the Commission from the very inception of its proceeding to allocate spectrum for a DARS service, in order to deliver reliable, high quality signals throughout their desired coverage area, the DARS licensees would have to install systems of terrestrial repeaters. In reality a DARS service has two components – a satellite system to provide national coverage and systems of terrestrial repeaters to insure coverage in local areas.

In IB Docket No.96-91, *Establishment of Rules and Policies for the Satellite Digital Audio Radio Service in the 2310-2360 MHz Band*, the DARS licensees have requested that the Commission permit as much as a 40 KW repeater operation. As explained by XM, which plans a system of approximately 1500 repeaters of varying power plus an unknown number of “microrepeaters,” its repeater system would be used “....in those limited areas where it may be difficult to receive satellite-based signals due to line-of-sight blockage from buildings, **and where the satellite signal receives interference from various terrestrial sources, such as microwave ovens.**”²⁶ The “limited areas” are contained in twenty to thirty mile circles around the largest seventy urban areas.²⁷ Unlike XM, Sirius’s repeater system will consist of repeaters at only 105 sites in the urban cores of 46 cities. It too plans to install some unknown number of comparatively lower power repeaters to overcome local obstacles.²⁸ Both companies have requested that the Commission place no limit on the number and power of terrestrial repeaters they may use.

It is difficult to estimate the degree to which the repeater systems will blanket large areas with signals strong enough to obviate interference from Fusion lamps. In

²⁶ See XM Radio, Inc. comments in IB Docket No. 95-91, filed December 17, 1999. (emphasis added)

²⁷ *Ibid*

²⁸ See Supplemental Comments of Sirius Satellite Radio in IB Docket No. 95-91, filed January 18, 2000.

many cases repeater transmissions will not be line-of-sight; there will be multipath reflections and repeaters of different sizes will be used. Thus, an estimate of coverage would essentially consist of a statistical analysis peculiar to a given region. Nevertheless, it is possible to make some generalizations. The DARS repeaters will, in many instances, provide line-of-sight transmission to receivers. Even a 1 kW repeater with an omnidirectional antenna mounted on top of a building should provide a strong line-of-sight signal for many miles that would easily overcome out-of-band interference from Fusion lamps. A 10 kW or 40 kW repeater would be significantly stronger blanketing much larger areas. Even where the transmission is not line-of-sight, it is likely that most areas in a city will be able to receive signals regardless of the presence of Fusion lights or microwave oven emissions.

As shown by an analysis performed by Daniel DiFonzo of Planar Communications Corp., even taking urban attenuation into account, a conservative estimate using the mean of peak emissions from the current production of the lamps tested, indicates that a single 1 kW repeater will protect DARS receivers from ISM interference at a distance of up to a kilometer.²⁹ A single 10 kW repeater will protect DARS receivers up to 2.3 kilometers, and a 40 kW repeater will do the job at a distance of up to 3.6 kilometers. Given that the DARS licensees' business plans call for multiple repeaters to blanket most urban areas, it is reasonable to assume that their transmissions will, in most cases, protect DARS receivers from interference from Fusion lamps.

Significantly, DARS receivers are not intended to be marketed only for use in vehicles but in homes as well.³⁰ For instance, XM claims it "will bring our revolutionary service into your home in 2001 with a brand new line of home stereo receivers."³¹ In fact, at least one of Em's radio manufacturer partners, Sony, is producing a "Plug & Play" radio that can be used either in vehicles or in the home. In a press release "Sirius Teams With Sony," Sirius explains the "relationship includes car, home and portable

²⁹ See Exhibit E

³⁰ It is too early to predict the success of efforts to sell DARS receivers for the home. It should be noted, however, that Section 302(a) of the Communications Act gives the Commission specific authority to "establish minimum performance standards for home electronic equipment and systems to reduce their susceptibility to interference from radio frequency energy." The Commission should consider whether the DARS receivers should be better designed to operate in their chosen environment.

³¹ See XM Radio website, www.xmradio.com/fl/howitworks/radios.asp

products.”³² One can only presume that it is the system of terrestrial repeaters that makes this ubiquitous use possible.³³

It is apparent, therefore, that the use of terrestrial repeaters will go a long way toward mitigating, and possibly solving, the interference problems from Fusion lamps. And the DARS licensees know it and have openly recognized the fact in their filings in this docket.³⁴ But, they argue, “[r]enquiring satellite DARS licensees to employ additional repeaters would be inefficient and costly” - this from XM whose terrestrial repeater budget is projected to cost more than half of its entire system.

Terrestrial repeaters have long been an integral part of every DARS business plan. Weak signals from space are simply not a solid foundation for a nationwide consumer service. Repeaters will solve many of space-based reception problems including out-of-band ISM emissions. Because the DARS licensees seem to be concentrating their repeater coverage over and around the largest cities, the targeted location for Fusion lamps, such areas will literally be blanketed with microwave energy to ensure acceptable reception of DARS service whether in vehicles or in homes. Thus, it appears that the DARS licensees will have their protection from out-of-band ISM emissions. Additional protection from Fusion is not required.

The Commission is Not Bound to Use its Processes to Reduce the Commercial Risk of the DARS Service

Ultimately, at issue is the proper interpretation and enforcement of Section 18.109 of the Commission’s rules:

ISM equipment shall be designed and constructed in accordance with good engineering practice with sufficient shielding and

³² Sirius Press Release of February 5, 2001

³³ In its Reply Comments in this Docket (August 4, 1998) Sirius (then Satellite CD Radio) sought to distinguish microwave ovens from Fusion’s lamps even though they use the same 2.45 GHz magnetron. Sirius argued that microwave ovens would be further away from its receivers, that they will be shielded by walls, and that they do not emit continuous energy. But, in fact, the DARS licensees fully intend that their receivers will also be located in homes – virtually co-located with microwave ovens and in line-of-sight. Moreover, there is no basis for arguing that the emissions from a microwave oven will not interfere with DARS receivers. As noted above, XM intends its repeater system to be used where “the satellite signal receives interference from various terrestrial sources such as microwave ovens.”

³⁴ See, Supplemental Comments, Attachment A, fn 12.

filtering to provide adequate suppression of emissions on frequencies outside the frequency bands specified in Section 18.301.

The DARS licensees, having failed to perform the requisite due diligence expected of competitive bidders in an FCC auction and having ignored the Commission's warning that an FCC license won at auction does not constitute a guarantee of business success, have nonetheless taken the risk of designing their businesses around receivers that they knew or should have known can not perform acceptably in the presence of out-of-band emissions from ISM devices that are more than 99% below the lawful Part 18 limits.³⁵ The DARS licensees now seek to protect their extraordinarily fragile systems and their investment in such systems – products of their own business decisions – by having the Commission declare that “adequate suppression of emissions” must mean whatever it takes to guarantee reception to DARS receivers, no matter the effect on existing businesses that have operated in good faith compliance with the Commission's rules for years. There is no requirement that the Commission interpret its rules to produce such an absurd and unfair result.

In fact, Fusion has designed its lights responsibly to suppress out-of-band emissions. The DARS licensees are correct when they state that compliance with the Commission's stated limits is not necessarily dispositive of compliance with the law. Clearly Section 18.109 is intended as a safety net for licensed services over and above the standards of the stated rules – but only up to a point. For this reason, one can expect a manufacturer to design its ISM equipment to suppress out-of-band emissions to an even greater degree than required by Section 18.305 of the rules. Fusion did this when it designed its lights so that, as noted above, out-of-band emissions are 20-34 dB below the limit of Section 18.305. Such a design was prudent since, should the Commission adopt the more stringent out-of-band limit it has proposed in this proceeding, Fusion lights will still comply. But prudence should not be confused with omniscience. No manufacturer could have conceived that a new licensee would come along demanding out-of-band peak emission limits 45 dB below the historic legal limits that applied to its products. It would

³⁵ The DARS licensees state that Fusion Sample lamp 1227 must be reduced 59dB, yet this lamp is almost 20dB below the lawful Part 18 limits. See Supplemental Comments, App. A p.6.

have strained credulity to presume the need for such foresight and it certainly strains credulity now to imagine that the Commission would ever impose such a limit.

The Commission has seldom had the opportunity or need to interpret Section 18.109, at least not formally. But the interpretation and enforcement of any rule must be reasonable and, ultimately, based on the public interest.³⁶ Fusion lamps are not just another lighting technology. According to an analysis of the DOE system, the two Fusion lamps produce four times the average luminence than the previously installed 280 mercury lamps and use approximately one-fifth the power at a savings of \$9000 per year.³⁷ When one considers that lighting consumes approximately 25% of the electrical energy used in the United States and about 5% of all BTUs from primary energy sources,³⁸ finding a lighting technology to operate with this efficiency can add immeasurably to the comfort of everyone in this country for years to come. At this time of national energy shortage, a regulatory restriction that effectively bans the deployment of an such emerging energy efficient technology would be a national travesty.³⁹

It simply cannot be in the public interest to force Fusion to write off tens of millions of dollars invested in this break-through technology as well as revenues from lost business opportunities by imposing an unreasonably strict interpretation of a rule intended to act as a safety net, not a warranty of commercial success. The fact is, the old saying about hard cases making bad law is still true. This situation should never have been allowed to happen. The DARS allocation ignored previous Commission concerns about ISM interference to DARS systems and the potential DARS applicants ignored the

³⁶ While under Section 18.109, ISM equipment is to be designed to provide “adequate suppression of emissions,” the term “adequate”, must be construed in the context of “reasonableness,” and it is likely not reasonable to construe Section 18.109 to require that manufacturers of existing Part 18 equipment be forced to redesign their products to protect later evolving devices that are poorly or improvidently designed. Moreover, one can argue that the Section 18.109 admonition is merely a baseline requirement applicable to ISM devices in general, but one which must give way to specific limits set forth in Section 18.305 with which the Fusion lamp complies.

³⁷ *An In-Situ Photometric and Energy Analysis of a Sulfur Lamp Lighting System*, D. Crawford, C. Gould, M. Packer, F. Rubinstein and M. Siminovitch, Lawrence Berkeley Laboratory.

³⁸ Annual Energy Outlook by the Energy Information Administration, Department of Energy. It should be noted that the 5% figure, 4.8 quadrillion BTUs does not include outdoor lighting nor the energy used by air conditioning to reduce heat caused by lighting.

³⁹ According to the Department of Energy’s Energy Efficiency and Renewable Energy Network, “Lighting also directly affects our economy. As a nation, we spend about one-quarter of our electricity budget on lighting, or more than \$37 billion annually. Yet much of this expense is unnecessary. Technologies developed during the past 10 years can help us cut lighting costs 30% to 60% while enhancing lighting quality and reducing environmental impacts.

ISM problem that was staring them in the face. At the same time, the Commission was well aware of Fusion lamps, had originally recommended the 2450 MHz spectrum for their use and had tested their emissions well before any DARS licenses were even up for auction.

In recent years, the Commission has shown that its system of preferential spectrum rights is not immutable. Just as ISM devices must protect licensed services in other bands, Part 15 devices must accept any interference, certainly interference from devices in licensed services. Yet in the LMS Docket, Part 15 spread spectrum device manufacturers sought and were granted a safe harbor against interference complaints from higher priority, licensed LMS operators.⁴⁰ In fact, the Commission went so far as to condition the grant of future LMS licenses on the licensee's ability to demonstrate through actual field tests that their systems would not cause unacceptable levels of interference to Part 15 devices. In that case the Commission did not accept the traditional hierarchy of licensed and unlicensed services but rather made a decision in the public interest. In this proceeding as well, the Commission must reach a decision firmly rooted in the public interest.

Fusion has spent millions of dollars developing an energy-conserving advance in lighting technology, funded in part by the Department of Energy and other agencies of the federal government, and so innovative that it is already on display at the Smithsonian Institution. It is necessary, therefore, for the Commission to resolve this Docket without adopting the draconian solutions requested by the DARS licensees that would wipe out two decades of public and private effort developing RF lighting in the 2.45 GHz band.

⁴⁰ See *Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Notice of Proposed Rulemaking, PR Docket No. 93-61, 8 FCC Rcd 2502 (1993); Report and Order, PR Docket No. 93-61, 11 FCC Rcd. 4695 (1995); Order on Reconsideration, PR Docket No. 93-61, 11 FCC Rcd. 16905 (1996).

Conclusion

Before “metal was bent” for the first DARS satellite, Fusion lights were illuminating federal office buildings in Washington, D.C. The DARS licensees cannot simply claim ignorance of the situation that existed before they tendered their bids. By accepting their licenses on conditions set by the Commission, they agreed to conduct due diligence **“before proceeding as they would with any new business venture.”** In the case of a new technology costing hundreds of millions of dollars and dependent for its success upon the reception by moving vehicles of very low power signals delivered from space, such due diligence should have been a thorough and sobering task. Instead, these licensees appear to have rushed into a new business with very little spectrum awareness. Could they have designed a more robust, albeit more costly, system or could they have delivered fewer but higher quality signals? They still have choices at a cost consistent with the scale of investment already made. They can ensure the adequacy of their service by sufficient placement of terrestrial repeaters to overcome ISM interference. The public interest would be better served by this approach than one which enlists the Commission to protect the DARS licensees from their faulty judgment.

And Finally

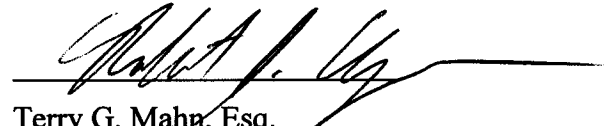
On May 16, 2001, Vice President Cheney submitted to President Bush the “Report of the National Energy Policy Development Group.” At the beginning of Section Four of that report, “Using Energy Wisely,” there are two pictures.⁴¹ The first shows the Fusion lamp illuminating the pedestrian plaza under the Forrestal Building in Washington D.C. The second is a full-page photograph of the Fusion sulfur lamp bulbs.

⁴¹ See Exhibit F

The Commission should consider the irony of one branch of the federal government hailing the Fusion lamp while another considers whether to extinguish it.

Respectfully submitted,

Fusion Lighting, Inc.

A handwritten signature in black ink, appearing to read "Robert J. Ungar", is written over a horizontal line.

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